

Multiscale analysis and validation of the MODIS LAI

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- Tian, Y., Woodcock, C. E., Wang, Y., Privette, J. L., Shabanov, N. V., Zhou, L., Zhang, Y., Buermann, W., Dong, J., Veikkanen, B., Hame, T., Andersson, K., Ozdogan, M., Knyazikhin, Y., and Myneni, R. B. (2001), **Multiscale Analysis and Validation of MODIS LAI Product, I. Uncertainty Assessment**. Remote Sens. Environ., 83:414-430.
- Tian, Y., Woodcock, C. E., Wang, Y., Privette, J. L., Shabanov, N. V., Zhou, L., Zhang, Y., Buermann, W., Dong, J., Veikkanen, B., Hame, T., Andersson, K., Ozdogan, M., Knyazikhin, Y., and Myneni, R. B. (2001), **Multiscale Analysis and Validation of MODIS LAI Product, II. Sampling strategy**. Remote Sens. Environ., 83:431-441.

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Introduction

As MODIS LAI data start to become publicly available, product quality must be ensured by validation.

Validation: the process of assessing the uncertainty of data products by comparison to reference data (e.g., *in situ*, aircraft, and high-resolution satellite sensor data).

Objectives

To develop an appropriate ground-based validation technique for assessing the uncertainties in MODIS LAI product.

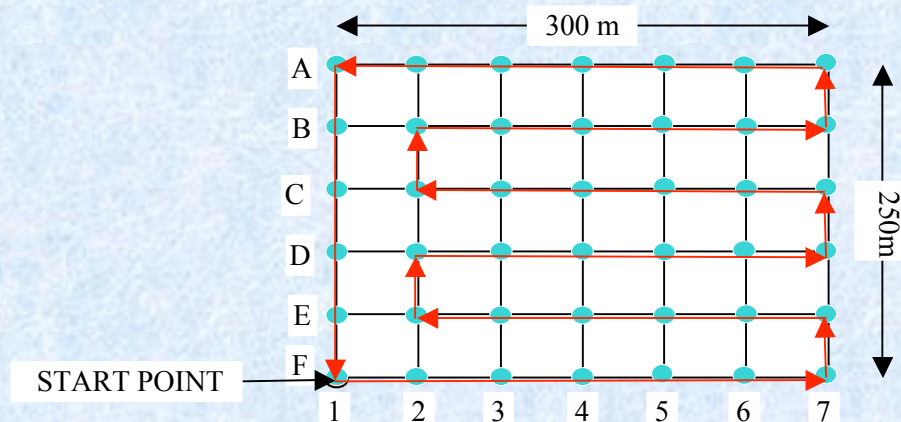
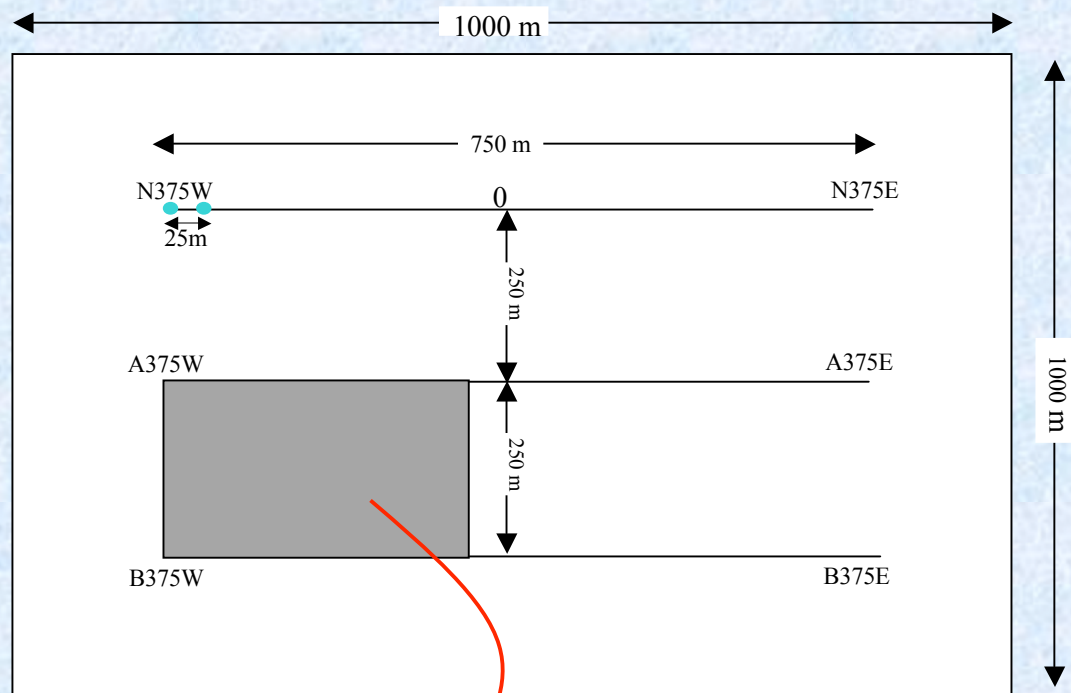
To develop sampling strategies to collect data needed for validation of the MODIS LAI product.

1. Validation of MODIS LAI At Maun

Field

Sampling

Scheme



Problems with validation

- Only few pairs of pixels between field measurements and MODIS data.
- Spatial registration is not accurate.

Solution



Data

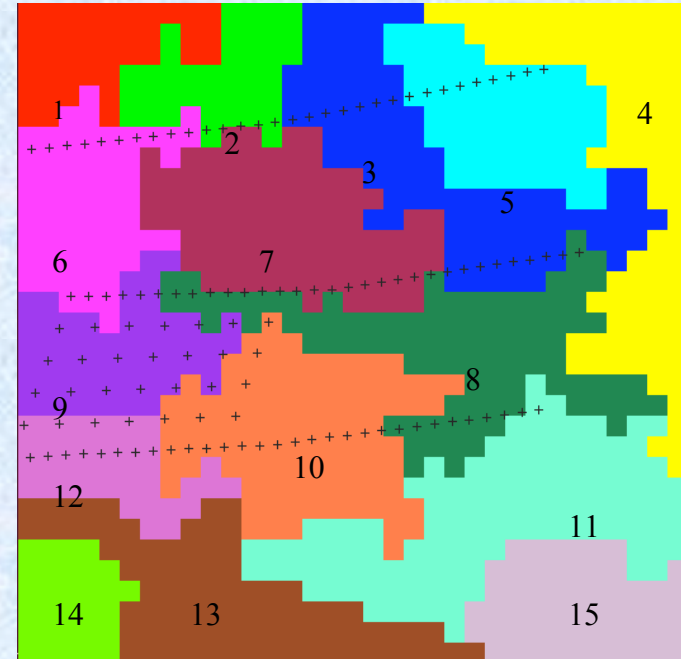
- LAI measured by LAI-2000 Plant Canopy Analyzer.
- Landsat ETM+ (30 m) data.
- MODIS reflectance data (1 km) simulated from ETM+.

Patch by Patch Comparison

ETM+ Image



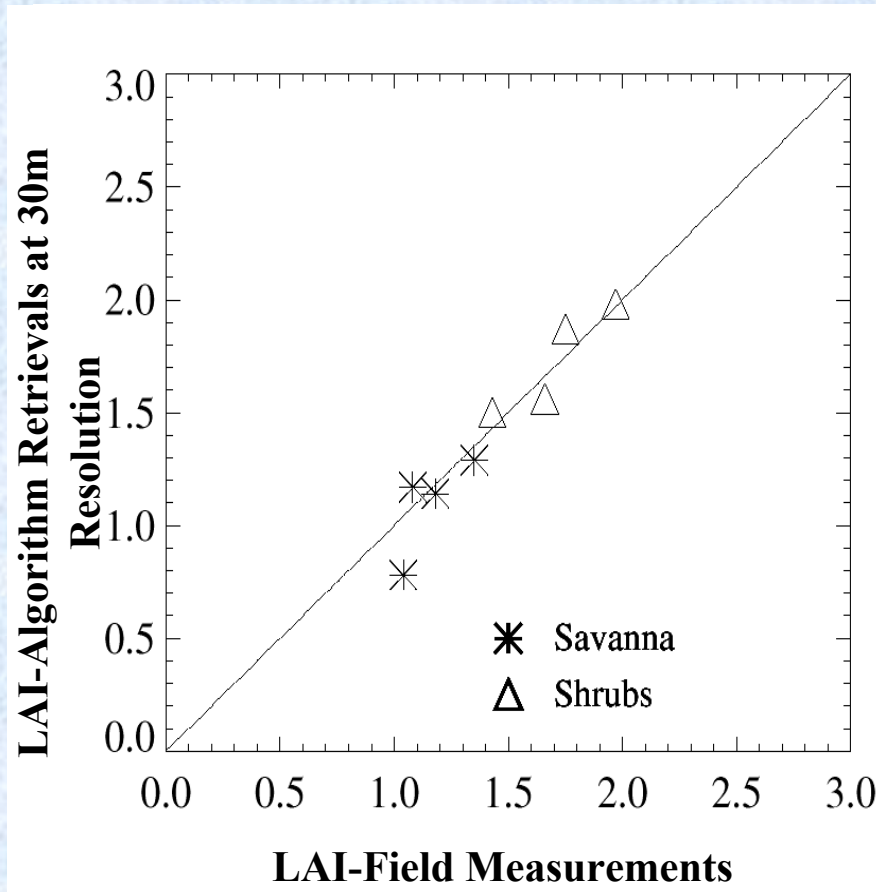
Segmentation Map



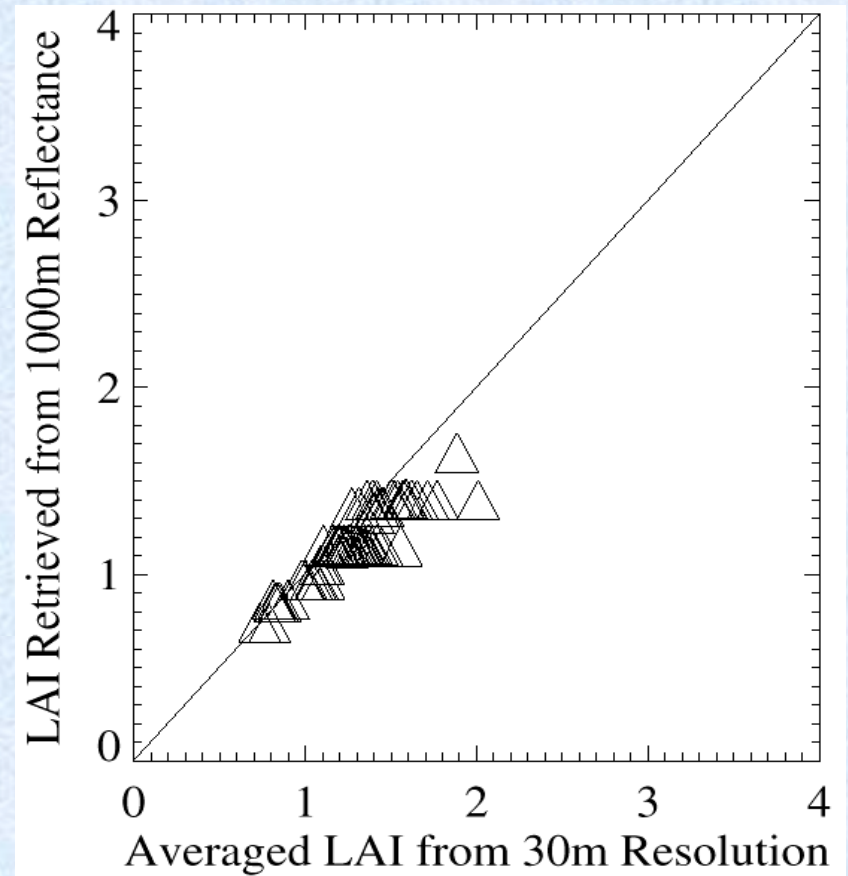
Shortcomings of pixel by pixel comparison

- GPS readings are not accurate.
- Measured LAI values have high variation over short distances.

Consistency between LAI Retrievals and Field Measurements

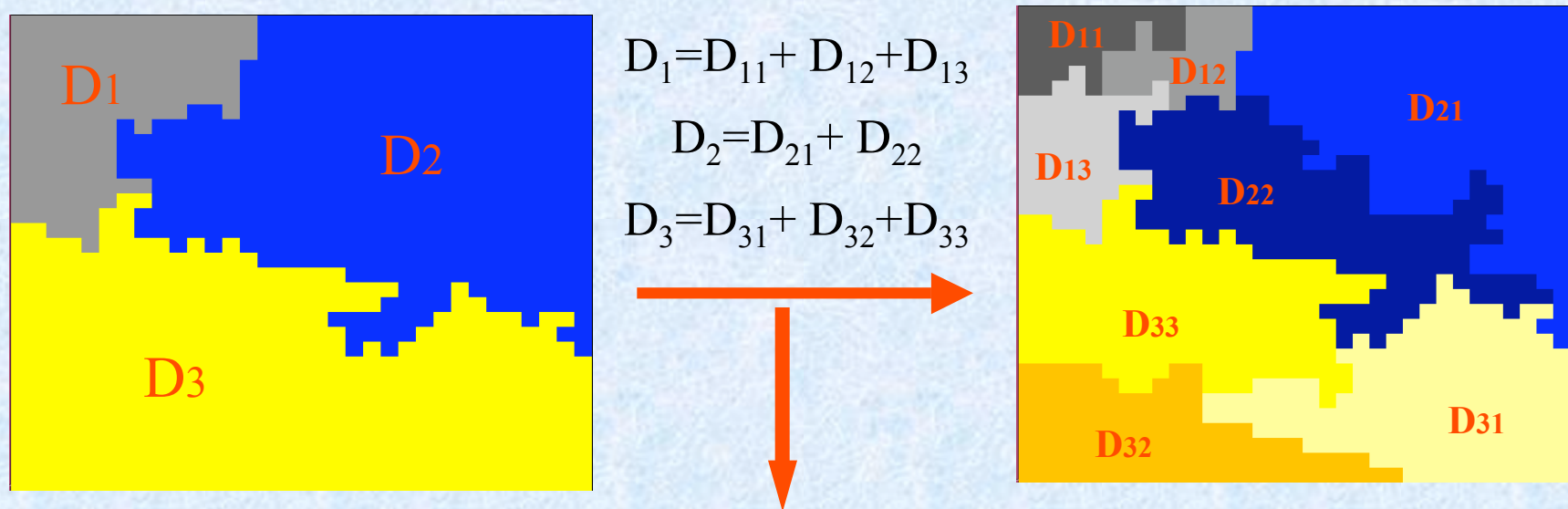


Underestimation of LAI for Coarse Resolution Data



2. Hierarchical Analysis of Multiscale Variation in LAI Data

A. Image decomposition four scale levels: whole image > class > region > pixel



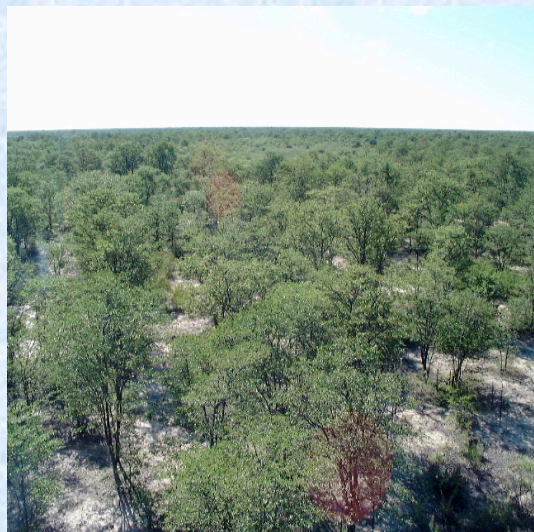
Four scale level images: image effect, class effect, region effect, pixel effect

B. Semivariogram Analysis for 4 Scale Level images

$$\gamma(h) = \frac{1}{2N(h)} \sum_{N(h)} [Z(x+h) - Z(x)]^2$$

Results from Three Sites

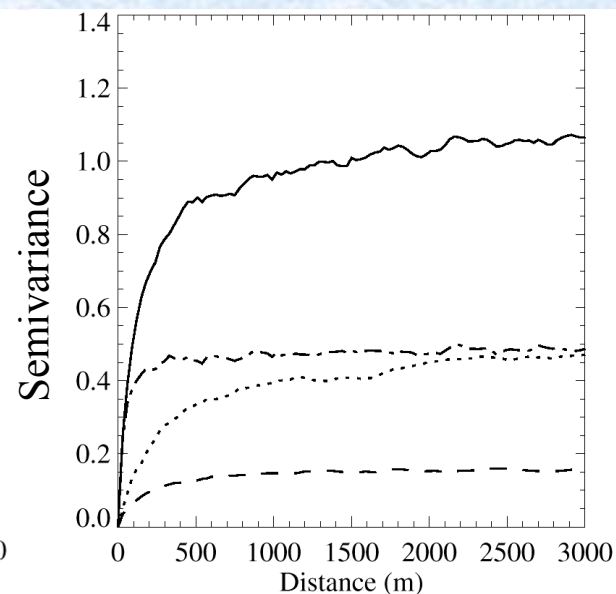
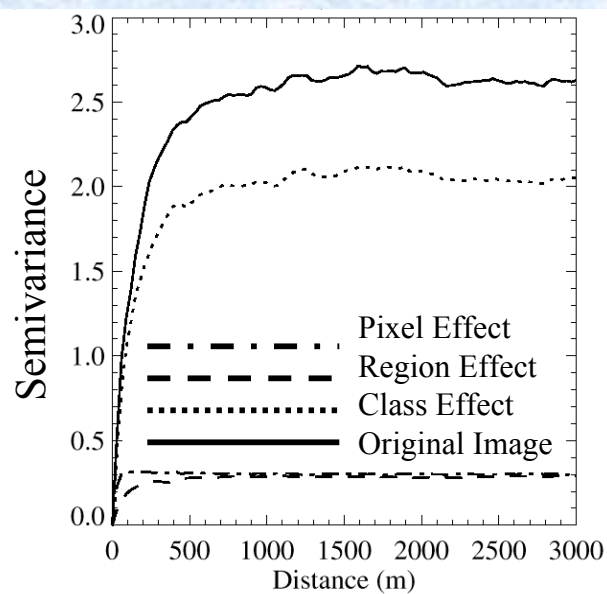
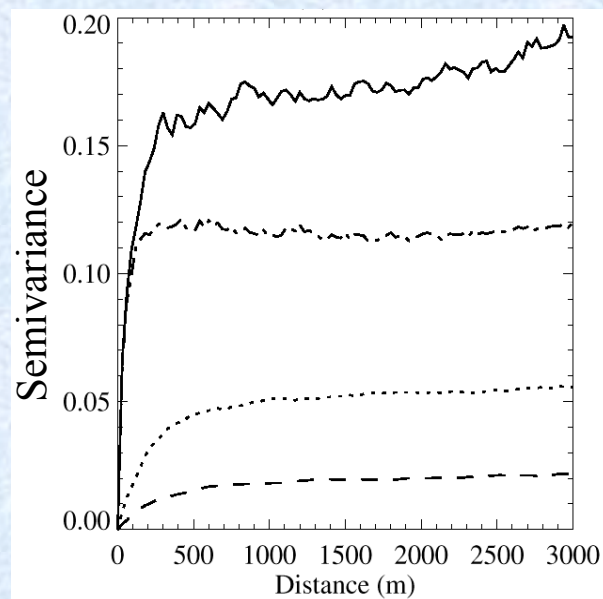
Maun (Botswana)



Harvard Forest (USA)



Ruokolahti Forest (Finland)



Conclusions

- Consistency between LAI retrievals from 30 m ETM+ data and field measurements indicates satisfactory performance of the algorithm.
- Hierarchical variance analysis shows that the LAI retrievals from ETM+ data demonstrate multiple characteristic scales of spatial variation.
 1. Within the three sites, patterns of variance in the class, region, and pixel scale are different with respect to the importance of the three levels of landscape organization.
 2. The spatial structure is small across the three sites. Validation needs to be performed over small areas.
 3. For validation activities, patches are better than individual pixels unless sample and registration accuracy are outstanding.